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DEVELOPING AN EPORTFOLIO AS A CAPSTONE EXPERIENCE FOR GRADUATE STUDIES IN INFORMATION SCIENCE: A PROCESS-TO-PRODUCT MODEL AND ITS IMPLEMENTATION

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Abstract

As the world is rapidly changing into a knowledge and information society enhanced by Internet technology in the 21st century, what should higher education do to prepare graduates for successful careers and well-balanced lives? A shift from teacher-centered pedagogy to self-directed learning is critical to ensure that our graduates are efficacious lifelong learners [1]. Since the turn of the century, pioneers in the field of education have sought new theories, innovative pedagogies, and best practices. Electronic portfolios, digital portfolios or Webfolios (hereafter ePortfolio) has been proposed as a learner-centered product of evidence learning and professional promise. Adopting ePortfolio is more than just an innovation in teaching and learning because educators are transforming education from a positivistic paradigm built on behavior theory to a post-modern paradigm or multi-paradigmatic approach built on cognitive and constructivist theories.

This study reports on the journey of developing an ePortfolio program as a capstone experience and the ongoing action research conducted to understand the experiences of ePortfolio students and their advisors, which contribute to program changes.

1 INTRODUCTION

What is an *ePortfolio*? Although there lacks an agreed-upon definition, ePortfolios in educational contexts typically refer to a collection of works to showcase a learner's outcome according to established standards, or a capstone product that integrates learning outcomes across the curriculum and demonstrates professional promise. [2]

The School of Information Sciences (iSchool) at the University of Tennessee at Knoxville (UTK) launched an initiative in 2009 to pilot ePortfolio as a new alternative to thesis and comprehensive examination as a culminating requirement for Master of Science in Information Science (M.S. in IS). An Ad Hoc committee worked on developing an ePortfolio guide. The pilot ePortfolio adopted a 5-area model [3]. The five areas, developed by an earlier adopter of ePortfolio for a Master's program in Information Science, include:

- 1 Intellectual argument or experience
- 2 Information technology competency
- 3 Teaching/training experience
- 4 Practical/service experience
- 5 Leadership

For each area, the student will present two products. Five pioneer students signed up for the ePortfolio pilot project in 2009 and graduated in 2011-2012. Built on the positive experiences of the graduates and their faculty advisors, the ePortfolio was adopted by the faculty as an official capstone option in 2012 and open to all incoming students. The ePortfolio Ad Hoc committee would continue its work to revise the ePortfolio guide. The 2012 ePortfolio guide adopted a new conceptual model as described in section 2. In 2015, a working group of faculty volunteers revised the 2012 guide, mainly in the part of oral defense (see section 3).

2 ePORTFOLIO CONCEPTUAL MODEL

An important development in UTK iSchool's ePortfolio is the new model in Fig. 1. This model guides the structure and content of the ePortfolio and has been tested by practice. Conceptualized as a process-to-product model, it articulates what ePortfolio is and how to develop an integrative ePortfolio.

ePortfolio is both a process and a product. As a process, the learner reflects on and self-assesses learning, collects evidence/artifacts, and organizes and integrates learning artifacts, reflections, and achievements in a personal/private repository (as the backend) throughout of the course of learning (the left part of Fig. 1). As a product, the learner creates a presentational ePortfolio to showcase learning and professional preparedness by creating a presentational ePortfolio on the Web using Web 2.0 application (the right part Fig. 1). The presentational Web ePortfolio includes the following five integrative parts:

- **Reflection** section summarizes the learning experiences and professional growth with a focus on the learning goals set up at the early stage of the program and the assessments of learning outcomes and achievements at the completion of the program.

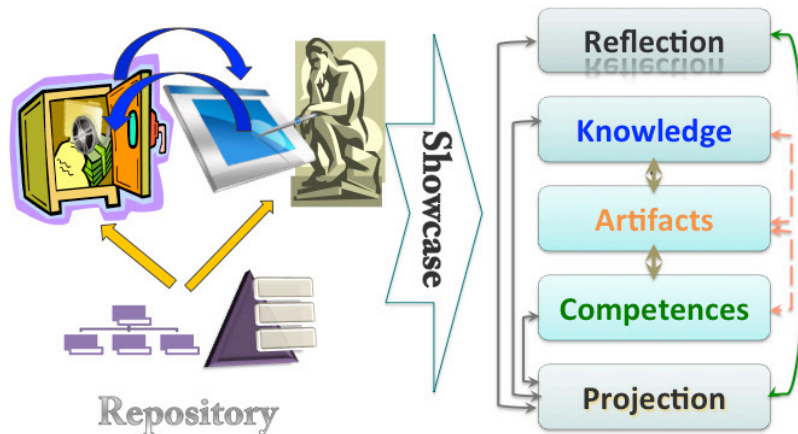


Figure 1. ePortfolio Conceptual Model.

- **Knowledge** section includes selected concepts or theories that the learner mastered and applied in the artifacts. Hyperlinks between the concepts or theories and the specific artifacts indicate the application of the concepts or theories to the artifacts.
- **Artifacts** section presents and reflects on selected projects and works created by the learner either individually or collaboratively. These artifacts illustrate the application of knowledge to and substantiate the claims of certain competences. The artifacts are hyperlinked to the concepts or theories discussed in Knowledge section; the artifacts are hyperlinked to the competences in Competences section.
- **Competences** section personalizes the learner's skills required for the planned career path. The learner articulates these skills and self-assess the level of the skills. Further each skill is hyperlinked to the specific product(s) or work(s) presented in the Artifacts section.

It is important to clarify the usage of *competence* vs. *competency* as [4] suggests: "...competences and competencies are not the same. Competences refers to the range of skills which are satisfactorily performed, while competencies refers to the behavior adopted in competent performance." (p. 7) Therefore, adopted by the ePortfolio model, a competence is referred to as a skill that enables the learner to produce the product.

- **Projection** section communicates what the learner, at the time of near graduation, visualizes his/her career future and how the learner plans to move forward professionally and personally. Also included in this section the learner's résumé.

This five sections plus required hyperlinks between sections define the information architecture for the presentational ePortfolio and provides flexibility for personalization. Although the final ePortfolios across learners have the same structure and content scope, the type of artifacts and competences vary across learners according to their chosen career paths [5].

3 IMPLEMENTATIONS OF UTK iSCHOOL'S ePORTFOLIO PROGRAM

The UTK iSchool's ePortfolio program has undergone three phases of implementation: 1) a pilot project, 2) a developmental stage, and 3) the current practice. During the pilot project, the students were given options to use either the content management system Drupal hosted in the school or any

other tools they have access. Starting from the developmental stage, WordPress has been adopted for ePortfolio development and presentation. Because the developmental stage followed the pilot project immediately, a technology must be decided quickly. Through investigation, the free WordPress was chosen. WordPress has been a reliable and easy to use Web 2.0 tool for publishing Blogs and hosting Websites. The advantages of using free Web 2.0 tools include that a quick launch of the program was feasible in the lack of additional IT resources to customize the campus-wide course management system, and the students would have the autonomy to continue their ePortfolios after graduation. As reported in literature, many of the universities that customized their course management systems to handle ePortfolios have faced the challenges of providing continuous support of the ePortfolios to their graduates or former students. The disadvantages of using free Web 2.0 tools, however, include that additional method or technology is needed to handle rubric-based evaluations, and limitations in personalizing or customizing themes that may have undesired features.

3.1 Pilot ePortfolio project (2009-2011)

As mentioned in the Introduction, the pilot project defined a five-area model adopted from another university's information science Master's degree program. The example ePortfolio from the pilot project in Fig. 2 shows the information architecture. Every of the five pilot ePortfolios has the same five areas. Each area is demonstrated by course projects or extra curriculum related activities such as student organization involvement. Each ePortfolio was defended with a three-member committee including the advisor and two faculty members who were serving the ePortfolio Ad Hoc Committee.

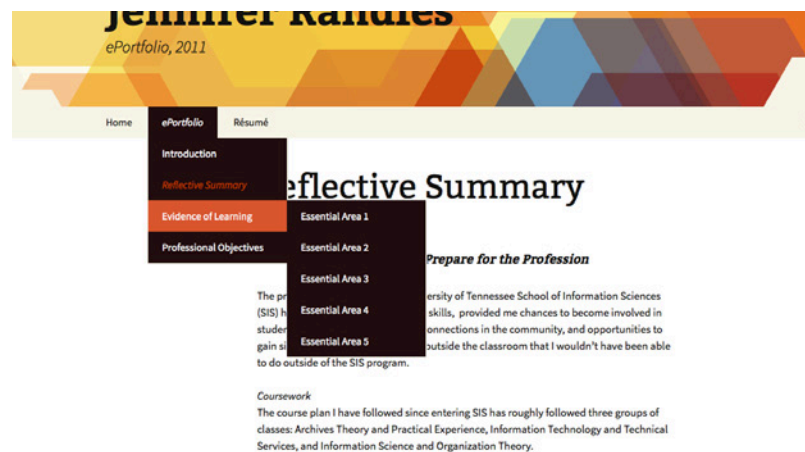


Figure 2. A Pilot ePortfolio (Five-Areas Model).

As part of the action research, a focus group interviewed the pilot ePortfolio students. All students felt that the ePortfolio experience was positive and rewarding; one student's potential employer was very much impressed with her ePortfolio. However, the students also identified the problem with the five-areas model: it was not in line with a self-regulated learning approach to support individual career paths. For example, one student struggled with the area *leadership*: "I plan to work as an IT specialist in a team. I am a good team player. But, I am not thinking of leadership position. This area is not relevant to me."

The faculty members who guided the students also found that the model limited personalized programming. In addition, the final ePortfolio was more like a collection of products. There was no mechanism to integrate across these essential areas. Students mostly built the ePortfolio Website in the last semester.

At the cross roads, questions arose: Should the school pursue further the ePortfolio option? If yes, what needed to change? Brownbag lunches were held to brainstorm the future of the ePortfolio. Almost all faculty members attended brownbags and contributed ideas. At the beginning of fall 2011, faculty approved a new proposal to develop a new guide based on the pilot experience.

3.2 ePortfolio and Showcase (2012 - 2016)

The challenges were real. The most important challenge was to create a new model to replace the five areas. What would it be? The Ad Hoc committee proposed to replace the five areas with three

dimensions: 1) knowledge, 2) artifacts/products, and 3) competences. Intensive work in the fall 2011 led to a draft ePortfolio guide, which adopted the *process leading to product* model and tackled the critical issues for implementation; in spring 2012, the draft was discussed and revised, and approved by the faculty on May 9, 2012. Several elements in the new guide included:

A new course was offered for students interested in doing an ePortfolio for capstone requirement

Five sections for the Web ePortfolio: Reflection (looking back), Knowledge (including 3 essays), Artifacts (including 4 products), and Competences (including 5 competences), and Projection (looking forward and a Résumé)

Wordpress was adopted and used adaptively for both the backend process (using posts, a blogging function, for reflective journal entries that are not published to the Web) and frontend product (developing pages and site navigations for presentational ePortfolio)

A ePortfolio showcase was held each semester for defense. Each ePortfolio must be defended and approved for graduation. Two members of ePortfolio committee would interact with the student at the showcase. Showcase had a public session following committee members' interactions with the students.

In Spring 2013, the first 7 students under the new ePortfolio guide graduated. Their experiences are important because, in a sense, this group of students piloted the new guide, although this stage was not named as pilot II. With willingness and determination, advisors and students journeyed together on a "learn as we go" adventure. From a different perspective, the 2012 guide's creative design allowed the ePortfolio to present 3 essays, 4 artifacts, and 5 competences. The information architecture delivers the content well (Fig. 3).

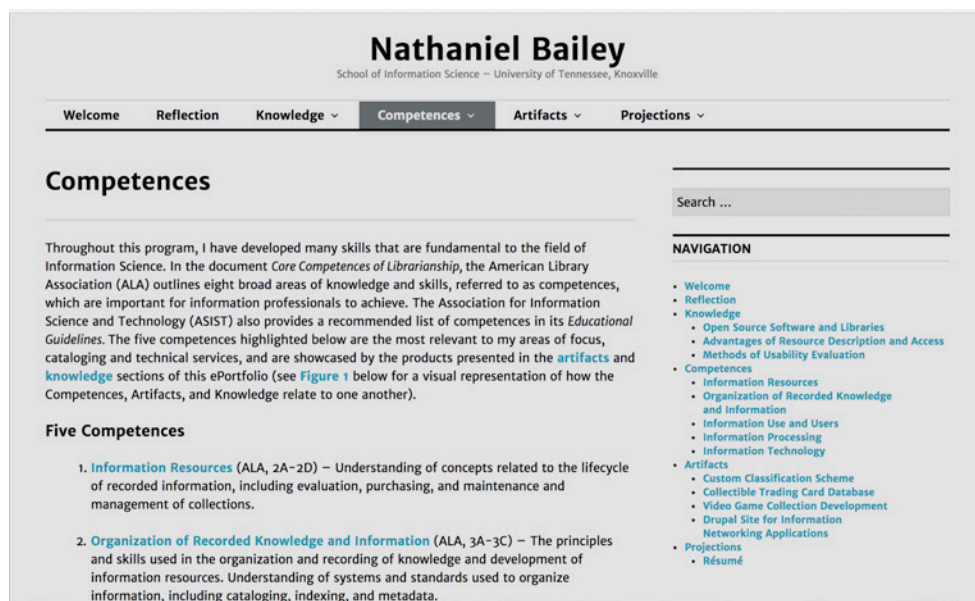


Figure 3. An ePortfolio Developed under 2012 Guide (2nd Edition).

Several issues were noted: the workload to produce the ePortfolio was overwhelming; some students faced challenges in adapting Wordpress for ePortfolio; some were confused about the differences between reflection vs. reporting. The ePortfolio course added additional materials to help overcome the difficulties. The most important action was to revise the guide by adding three components as follows:

Milestones to monitor the progress of the ePortfolio development. A matrix mapped out the tasks and the timeline for engaging in the tasks. For example, setting learning goals and program planning should be completed in second semester; writing 3 knowledge essays would be completed cross several semesters as well as collecting and reflecting on artifacts.

Rubric with seven criteria to help improve quality was useful for advisors and committee members: C1. Relevancy of concepts/theories; C2. Artifacts effectively demonstrate competences; C3. Professional preparedness; C4. Quality of writing; C5. Site usability; C6. Critical thinking, C7. Résumé.

Q & A to clarify some confusion. For example, when the required ePortfolio course should be taken. Earlier is better; typically the second semester.

This revised guide was approved on December 4, 2013 and designated as the 2nd edition.

3.3 Current ePortfolio practice (2015 -)

Students who were earlier adopters of ePortfolios share some personal traits such as adventurous and ambiguity tolerance. The showcases scheduled for four hours each semester with two evaluators had worked well with 10 or fewer students defending. The number of students interested in completing a capstone ePortfolio grew quickly; it doubled in Spring 2014 and this trend was expected for the next few years. The challenge is to maintain a scalable ePortfolio program without additional faculty resources. How to accommodate a wide range of students without sacrificing ePortfolio quality? The faculty decided that it was the time to review the ePortfolio practice and look for innovative ways to maximize faculty resources to guide students in designing and developing an efficacious ePortfolio.

In spring 2015, five faculty members, led by the author of this article, volunteered to form a working group to revise the school's ePortfolio program officially in place three years ago. Several major changes to the model and the procedure included:

- Knowledge-Artifacts-Competences (KAC) would be an integrative whole, although remain as three sections structurally. The 3 knowledge essays would be about the concepts and theories *applied* to the selected artifacts. Knowledge section was now related to the artifacts rather than stand-alone
- Artifacts section would require a minimum of three artifacts instead of four artifacts. This reduction in quantity was intended to help increase quality of analysis and integration across sections.
- A matrix as a tool to visualize how KAC elements are inter-connected would give an integrative view (Fig. 4). There would also be built-in hyperlinks to provide direct access to an artifact, a concept, or a competence.

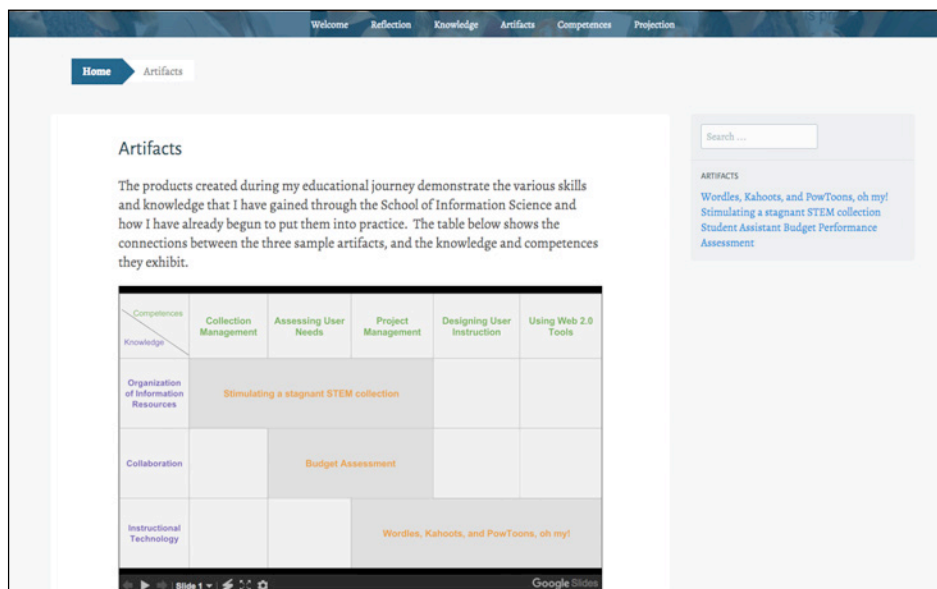


Figure 4. Knowledge-Artifacts-Competences Matrix from 2015 Guide.

- Replace the ePortfolio showcase with an individual committee of three members for oral defense; the individual defenses could then be scheduled much more flexibly.
- A new 3-milestone defined the progress of the ePortfolio process: 1) the student would work with an ePortfolio advisor at the time of taking the ePortfolio class to set up learning goals and make program plans; 2) the student would produce a prototype before inviting ePortfolio committee members; 3) the student would submit the advisor-approved ePortfolio to committee prior to defense.
- Two new rubrics were used for peer reviews: one focused on site information architecture and the other on the quality of the prototype in terms of reflection and analytical integration.

The revised ePortfolio guide was discussed and approved by the faculty on November 18, 2015. All incoming students would follow the new guide; a phase-out schedule would allow the current students to defend their ePortfolios either in Showcase under the 2013 guide by fall 2016 or before a committee following the new guide.

The 2015 guide does not change the model or site information architecture. Rather it strengthens integrative reflection [6, 7] and effective writing for the Web platform [8, 9]. Corresponding to the revision, the ePortfolio course has also emphasized the analytical and integrative method to guide reflections. For example, the assignments to develop the ePortfolio prototype practice the analytical method to analyze one's own work. By stepping back to take a critical look at the work, the learner identifies the concepts or theories that the learner applied to the artifact and the competences and skills that enabled the learner to produce the artifact (Table 1.) When presenting an artifact, the first two columns will be the materials for the artifact page, a brief mentioning which knowledge concepts and competences the artifact substantiates. If a concept is discussed in the Knowledge section, a hyperlink is made to the concept in the Knowledge section. If the competence is discussed in the Competences section, a hyperlink is made to the competence in the Competences section.

Table 1. Analytical Method to Artifact

What it is	What I did	Knowledge	Competences	Reflection
<ul style="list-style-type: none"> • Context • Situation • Process 	<ul style="list-style-type: none"> • Led the group • Collect data • Organize data • Analyze data 	<ul style="list-style-type: none"> • Career resources • Classification • Database modeling 	<ul style="list-style-type: none"> • Research • DBMS • SQL • Leadership 	<ul style="list-style-type: none"> • My research ability • My technical skills • My strategies to solve team conflict

The required ePortfolio course also adopts peer review—implemented as a single-blind review in which the reviewers know whose site is being reviewed, but the submitted review comments are anonymized unless the reviewer chooses to sign it. Reviewing is guided by the two rubrics. In doing the peer review assignments, students not only help others but also understand the rubrics better.

Fig. 5 shows an artifact page with reflections. The color-coded texts distinguish different types of links: the texts in orange to the actual *artifact*, the texts in blue link to the *concept* in Knowledge page, and the texts in green link to the *competences*. Because the artifact is a database, readers of this artifact would need to have the DBMS system installed on the computer. To present the database effectively, the students created a video presentation.

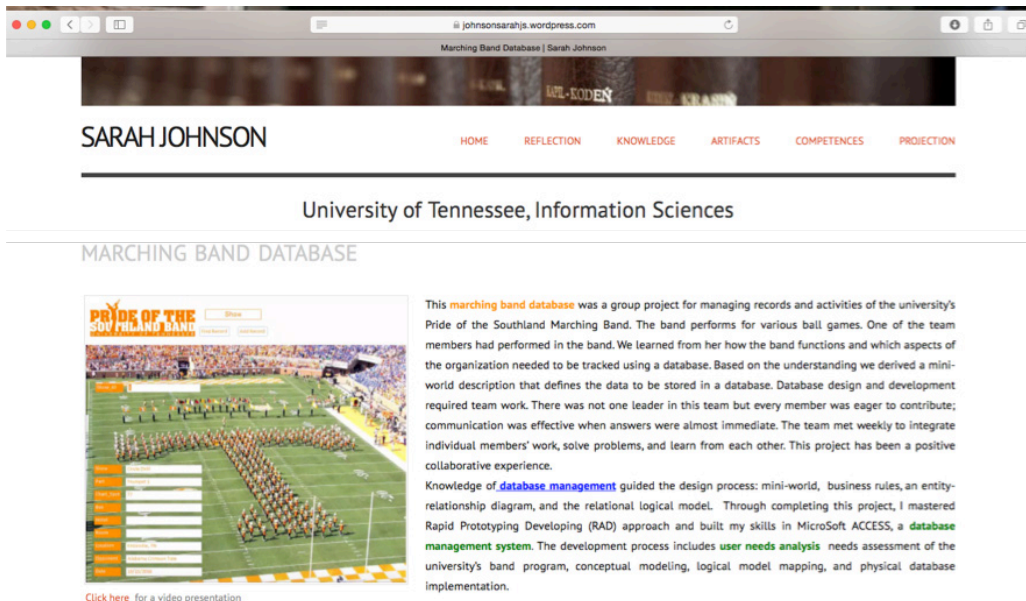


Figure 5. An ePortfolio Artifact page with Colored Links to Knowledge and Competences.

3.4 Summary of UTK iSchool ePortfolio program

The trend as predicted and seen is a significant increase in the number of students taking ePortfolio as a graduation capstone. Fig. 6 shows a steady increase of the percentage of the ePortfolio graduates from 10% to 50%. (The pilot ePortfolio graduates in AY 11-12 were not included.)

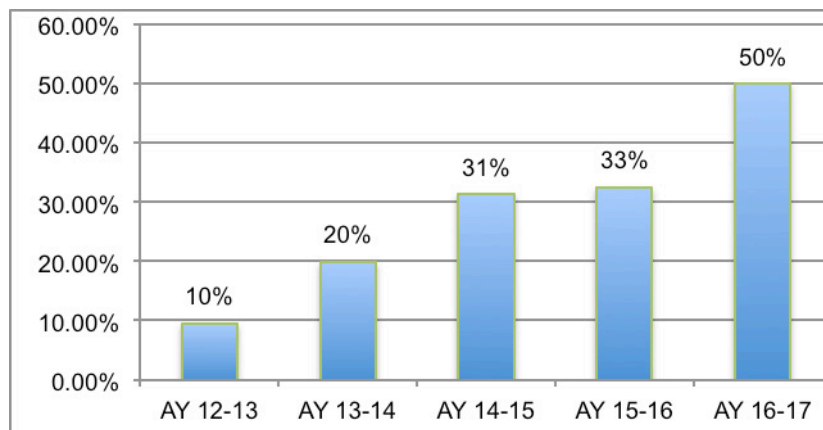


Figure 6 Graduates Completed an ePortfolio per Academic Year

4 RESEARCH ALONGSIDE PROGRAM DEVELOPMENT

Starting from the pilot in 2009 to current practice, studies using multiple methods (e.g., surveys, interviews, brownbag discussions, and focus groups) have been conducted with the participation of ePortfolio graduates, advisors, committee members, faculty, alumni, and peer IS programs. The purpose of these studies is three-fold: to seek feedback on their experiences, to verify the conceptual model, and to identify issues or concerns. The ultimate goal of the action research in the context of ePortfolio is to gain insights into how to better facilitate ePortfolio practice to effectively leverage its potential. The findings have been incorporated in a timely manner into decision-making and changes to the model and the procedure. These finding-based decisions have been mentioned in the three stages (Section 3). Reported here are comments that share ePortfolio experiences. A systematic analysis and report of the studies will be published in a future paper.

The feedback of pilot project led to the revision of conceptual model. (see section 3.1)

At the end of the required ePortfolio course, students reflect on their experiences of creating a prototype ePortfolio and their preparedness of developing a capstone ePortfolio. One wrote:

I'm so glad I chose the ePortfolio capstone option. Already, I have much better grasp on what I want and what my plans are. Having to define my goals in writing keeps me focused. It also helped me make better choices when signing up for classes for next semester. In the rest of my time here, I hope to strengthen my competences related to description and organization. Also, I plan to tailor my classes towards knowledge relevant to historical societies and other history organizations. Finally, I'll continue to supplement my coursework with volunteering and learning programming languages.

There, however, times, a student may decide not to pursue an ePortfolio:

I have actually decided to go with comps as my capstone requirement instead of ePortfolio. ... That does not mean I leaving this course not having gained anything. I have learned a new way of thinking and reviewing my work, a style I was never really trained in, and while I'm still not 100% comfortable in it I feel like I have the skills necessary to keep practicing and increase my comfort level. I have one semester left in the program and will be spending the time focusing on the more technology specific aspects of the program, which I feel will give me a very rounded basis of knowledge to begin my job search at the end of this year. The reflective learning and reading skills I have learned during this class I feel are invaluable no matter whether I continue with the ePortfolio.

Under the *process-to-product* model, ePortfolio graduates report that they have put between 60 to 200 hours into the development of the ePortfolios over several semesters, most intensively the semester they showcased or defended ePortfolios. ePortfolio advisors estimated the time for ePortfolio students varies depending on the student; some held weekly meetings others met fewer times. Advisors commented that students who were able to produce high quality writing and good Web design were easier to guide than those who were not strong in writing or Web technology. The majority of the students were proud of their final ePortfolios. Here are a few quotes from surveys of ePortfolio graduates:

The only reason I chose this was to create something I can show potential employers.

I really felt that the ePortfolio option was the best option for me because I was able to exhibit my knowledge gained from the program and I am really proud of what I created. ... if this was not an option, I would have had to do the comprehensive exam and I feel that would not have given me a product that I could showcase and use in the future. The thesis option would have given me a product but was more course hours than I could devote. The ePortfolio allowed me to show my professionalism in a way that is easily navigable and usable. It was the perfect option for me and gave me a new tool to document and reflect my learning progress that I will take with me into my future career.

The actual process of creating, modifying, and presenting the ePortfolio was an excellent experience overall.

The most memorable experience is bonding with an excellent advisor and being proud of my work.

... my most memorable moment was the realization that I would have a definitive product through which I could display my best work.

The biggest challenge is creating cohesion and representing myself fully. It was a challenge for each page to stand alone and yet avoid redundancy. What I would do differently: more reflection. I was pretty good about keeping up with my reflections, but I would have liked to do more and started in my first semester. Also, I wish that I had been able to incorporate more technologically components into my ePortfolio.

5 CONCLUSIONS

ePortfolio as a Master's degree capstone requirement is a new pedagogical innovation that has great potential to empower learners to achieve personalized competences and foster lifelong learning habits and skills. The *process-to-product* model is rigorous and the five integrative sections architecture is flexible to accommodate the needs of different career paths. A good model does not ensure smooth sailing because reality is complex and context-bound.

Despite the uncertainty during the process and the extra workload to create and evaluate ePortfolios, both students and faculty involved in the adventure of the past eight years see ePortfolio as a viable capstone option. To maximize the positive feelings during the process of developing ePortfolios, a close collaboration between student and advisor is important. To minimize negative feelings towards committee's comments, prepare ePortfolio students to understand and practice the peer review process earlier on and understand reviewer's role as devil's advocate.

Action research should be carried out in parallel with any pedagogical innovation to provide insights and to make research-based decisions on how to improve the practice. The next research agenda should identify the factors influencing successful ePortfolios. Specifically, the following questions need to be explored: (1) The effect of personal traits on students' experience in developing an ePortfolio—Ambiguity tolerance (high or low), goal-orientation (extrinsic vs. internal), and (2) How to tailor advising for ePortfolio students.

Calling for higher education reform has been well articulated. However, much needed reform in higher education is often the most difficult to carry out. Many programs in information sciences (IS) are seeking innovative ways to transform teaching and learning. Currently, there are still fewer IS programs with a capstone ePortfolio requirement. The current situation is that although many IS programs are interested in adopting ePortfolios, some of the earlier pioneers have discontinued having an ePortfolio as a graduation requirement. One such IS program that no longer offers ePortfolio capstone option pioneered the five-area model that this school adopted in its pilot phase.

The eight-year experiences of UTK iSchool ePortfolio show that the success of educational initiatives needs passionate and persevere leaders, faculty buy-in and enthusiastic participation, strong administrative support, and motivated and engaged learners.

ACKNOWLEDGEMENTS

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The content of this work is solely the responsibility of the author.

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